AES Huntington Beach
NPDES / 316(b) Technology Alternatives Assessment Status Report

September 13, 2007

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Topics Covered

- NPDES 316(b) Requirements
- Impingement and Entrainment Characterization Study
- Technology and Operational Measure Evaluation Status Report
- Discussion

NPDES 316(b) Requirements

- Permit issued August 26, 2006
- The permit Issued with BPJ §316(b) Requirements
- Standards based on a combination of Federal Phase II Rule and Draft SWRCB Policy
- Requires submittal of a Comprehensive Demonstration Study (CDS) by January 7, 2008
- Santa Ana Board to consider permit modifications in light of the Rule's remand based on information provided in the CDS
- The CDS preparation is on schedule for submittal by January 7, 2008

Impingement and Entrainment Studies

Study Timeline

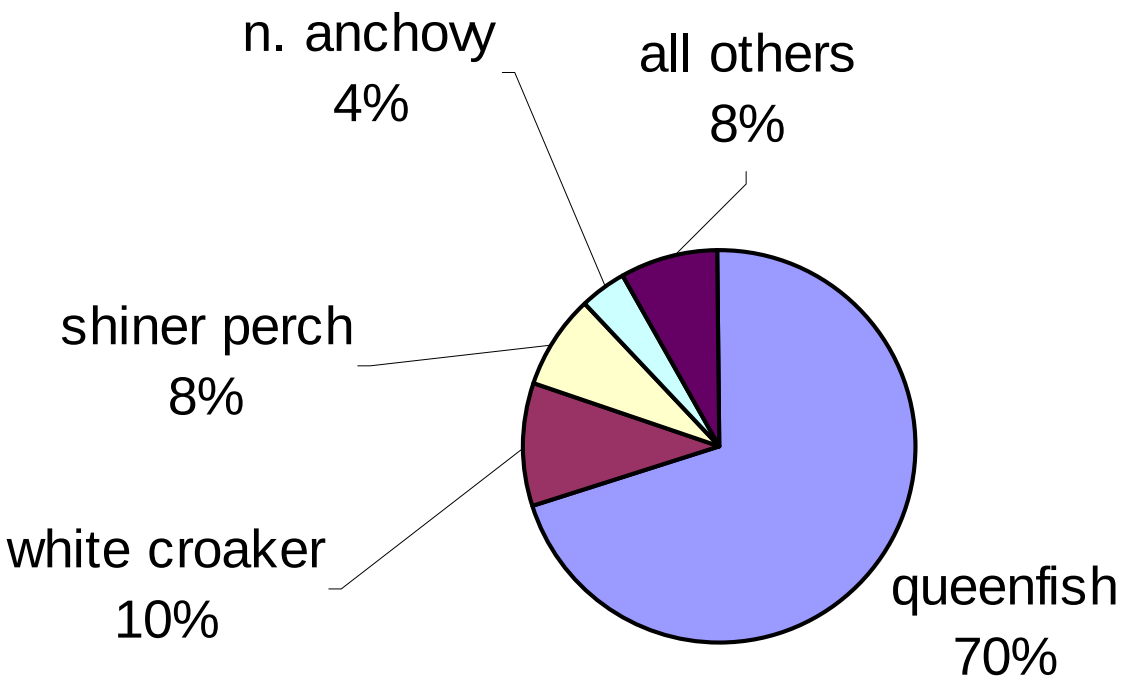
- 2000 AES submits application to re-tool Units 3&4 to the CEC
- 2001 CEC requires one-year IM&E study
- 2003-4 IM&E study conducted
- 2005 Final Report submitted
- 2006 AES, CEC, and HBWC draft an agreement for restoration of 66.8 acres of wetlands at Huntington Beach

Study Oversight

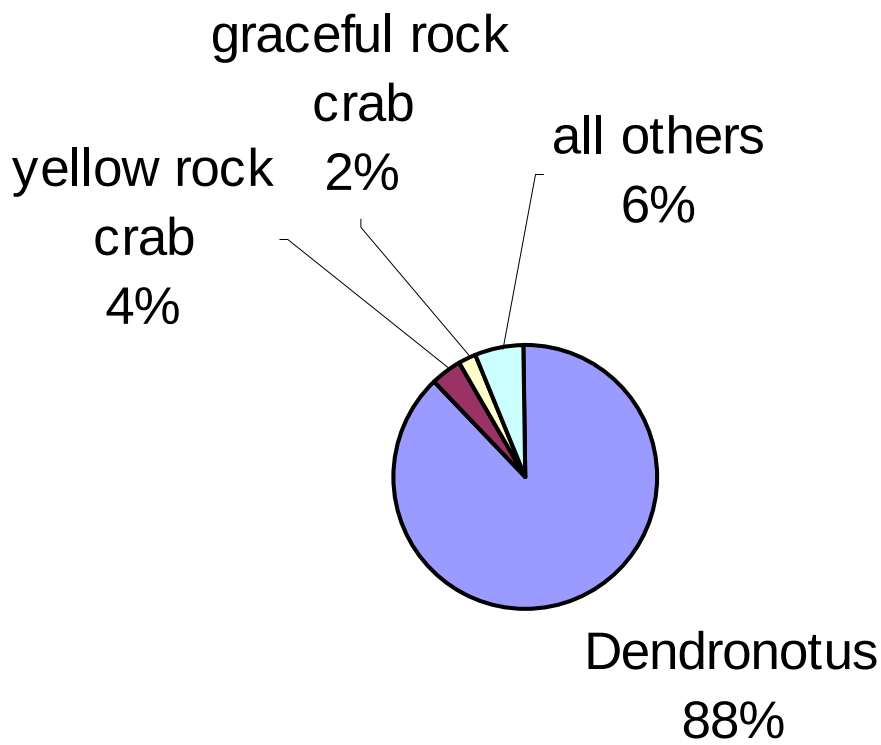
- AES HBGS
- Santa Ana RWQCB
- CEC
- CDFG
- NMFS
- U.S. Fish & Wildlife

The working group provided comments on the design of the study, quarterly data reports, draft reports, and mitigation recommendations.

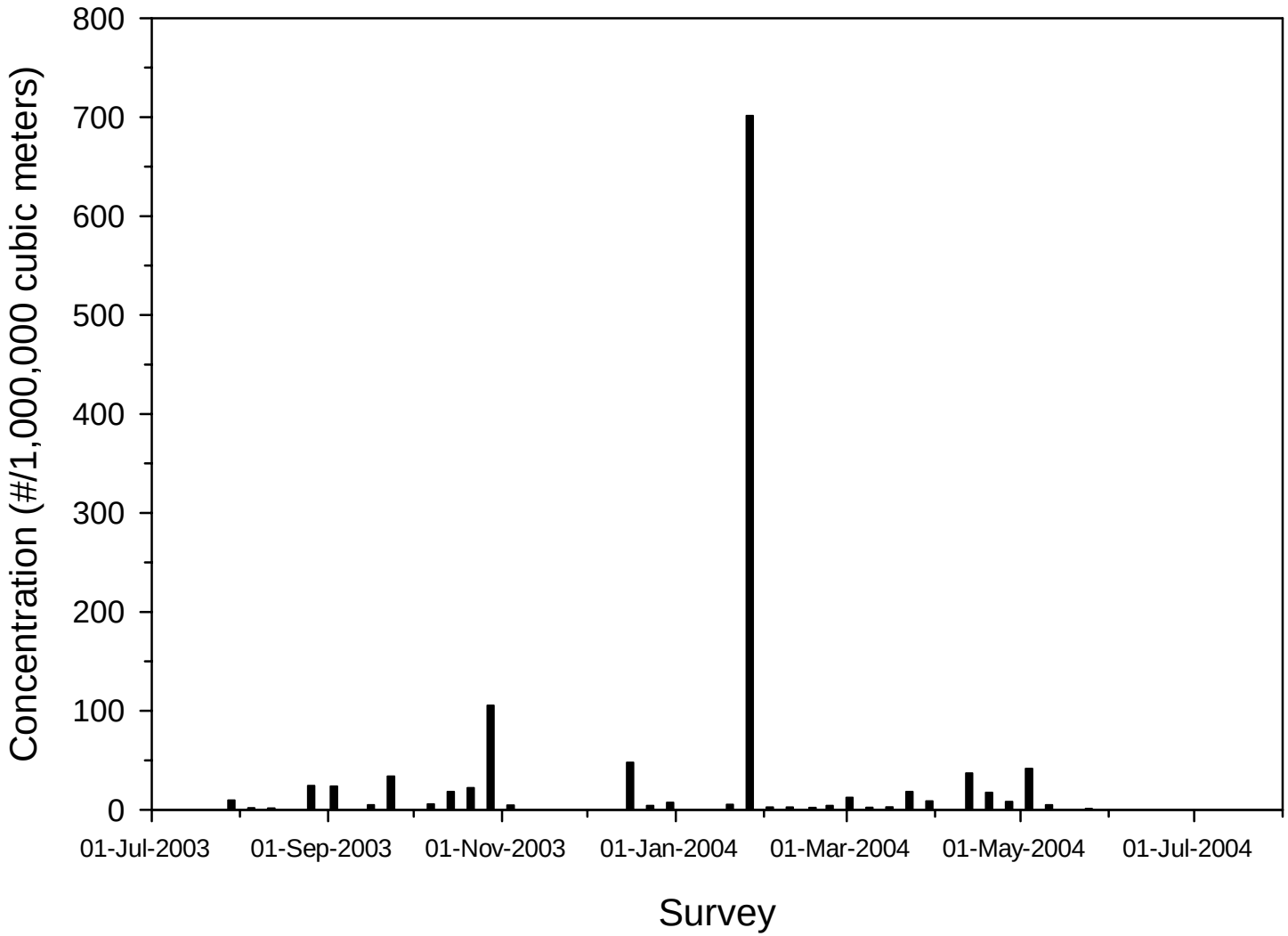
Impingement Results



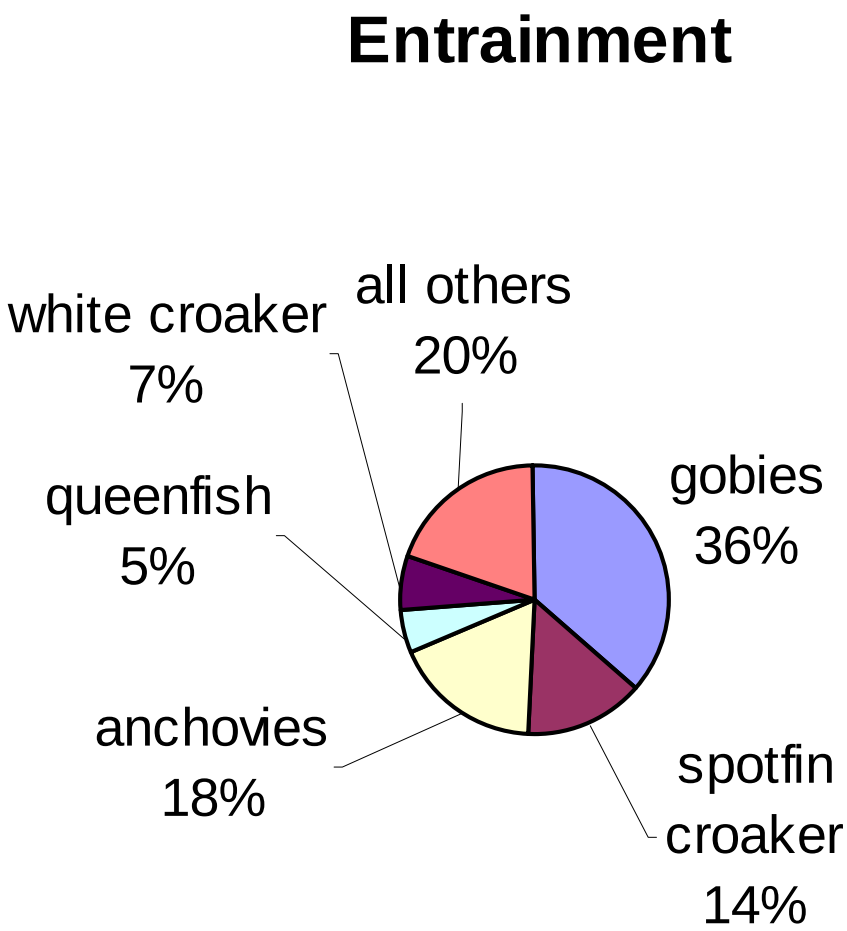
Impingement Results (*Cont.*)



Impingement Seasonality

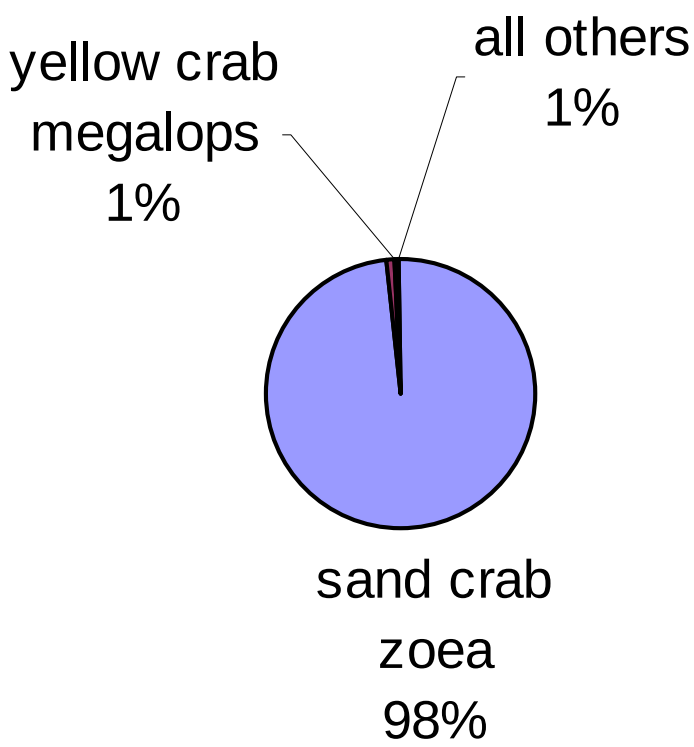


Finfish Entrainment Results

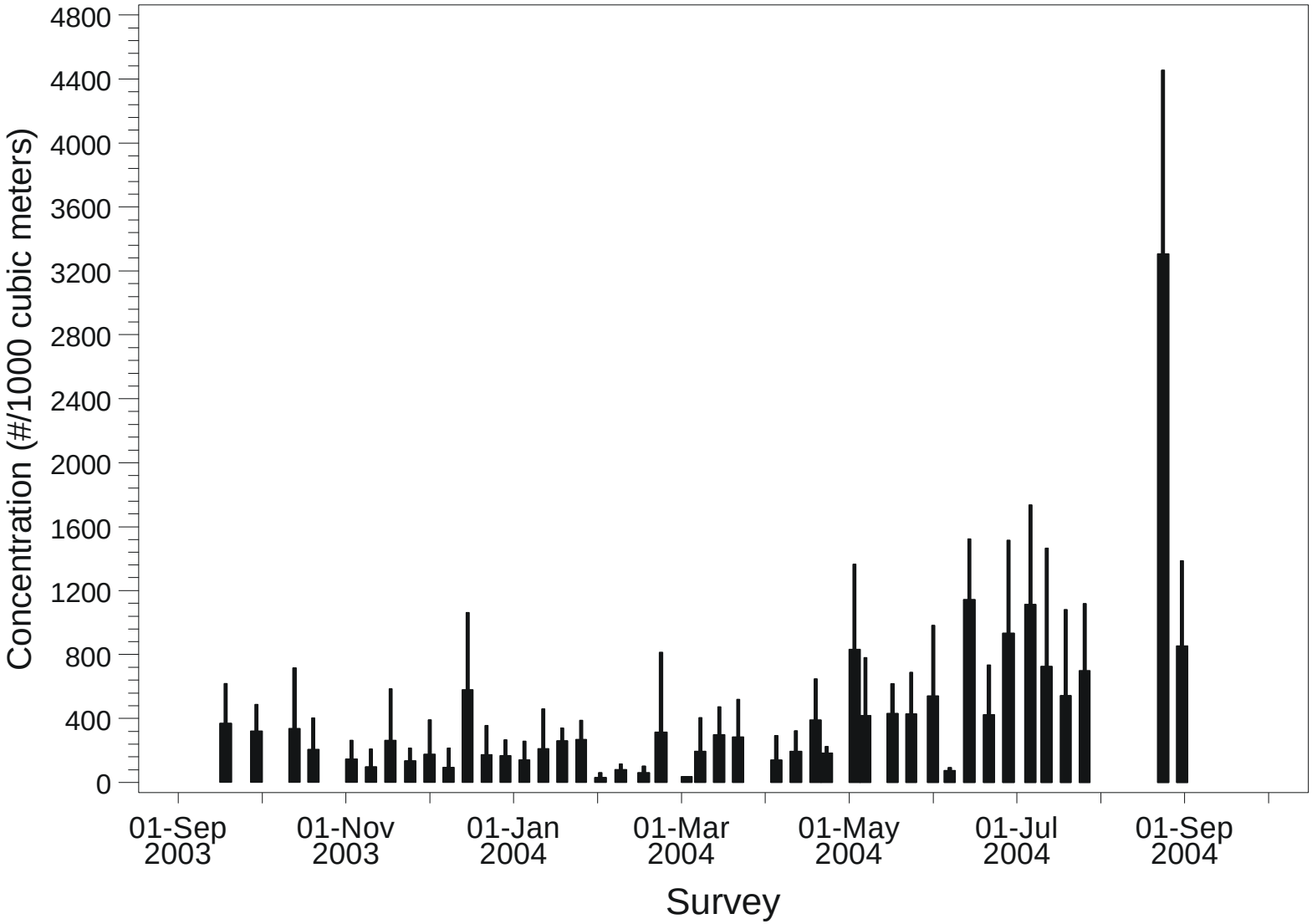


Shellfish Entrainment Results

Invertebrate Entrainment



Entrainment Seasonality



Calculation Baseline

- AES submitted proposed methodology for Calculation Baseline estimate in fall 2006:
- Data from 2003-4 IM&E Study
- Flow data:
  - Actual flow from 2004-5 (post re-tool)
  - Design (maximum) flow
- Analysis accounted for intra-annual flow variations
- Estimate took into account published effectiveness of the velocity cap in reducing impingement

HBGS Velocity Cap Effectiveness Estimate

Year	Velocity Cap	Species (time)	Entrapment Density	Effectiveness
1980	No	All (daytime)	47.2 kg/hr	
1980	Yes	All (daytime	0.65 kg/hr	99%
1980	No	All (Nighttime)	52.99 kg/hr	
1980	Yes	All (Nighttime	6.78 kg/hr	87%
1980			Average:	93%
1979	No	All (day/night 18 hr)	20.45 kg/hr	
1979	Yes	All (day/night 18 hr)	1.97 kg/hr	90%
1979	No	All (Nighttime)	32.93 kg/hr	
1979	Yes	All (Nighttime	15.53 kg/hr	53%
1979			Average:	72%
1979 and 1980 Combined Effectiveness				82%*

~ 87% based on entrapment vulnerability (i.e. fish densities in vicinity of intake or discharge based on flow mode)

Calculation Baseline

Actual Flow	No Velocity Cap	Velocity Cap
Fish	256,000	46,000
Shellfish	8,000	8,000

Design Flow	No Velocity Cap	Velocity Cap
Fish	373,000	67,000
Shellfish	11,000	11,000

IM&E Results

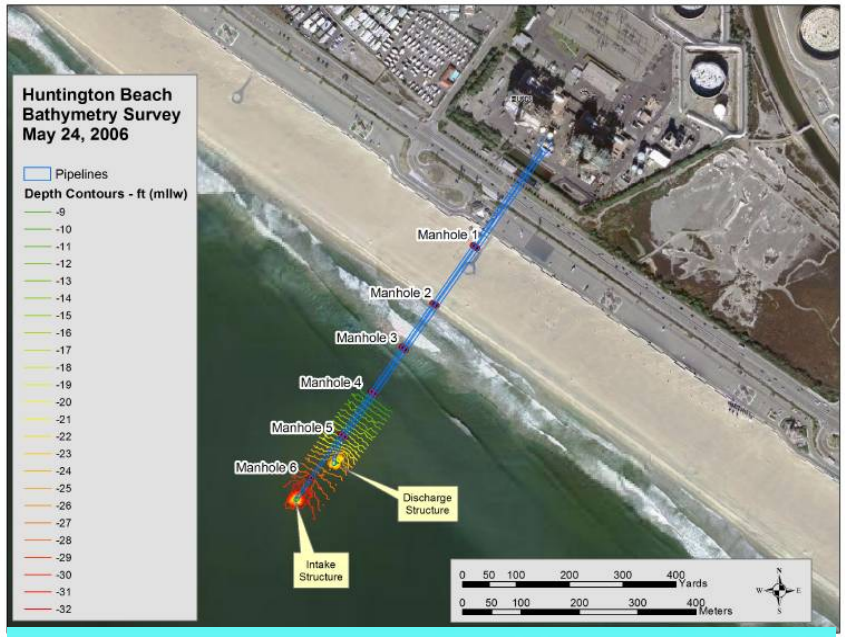
- Entrainment – Probability of Mortality (*Pm*):
- 0.28% for nearshore fish taxa
- 0.45% for gobies

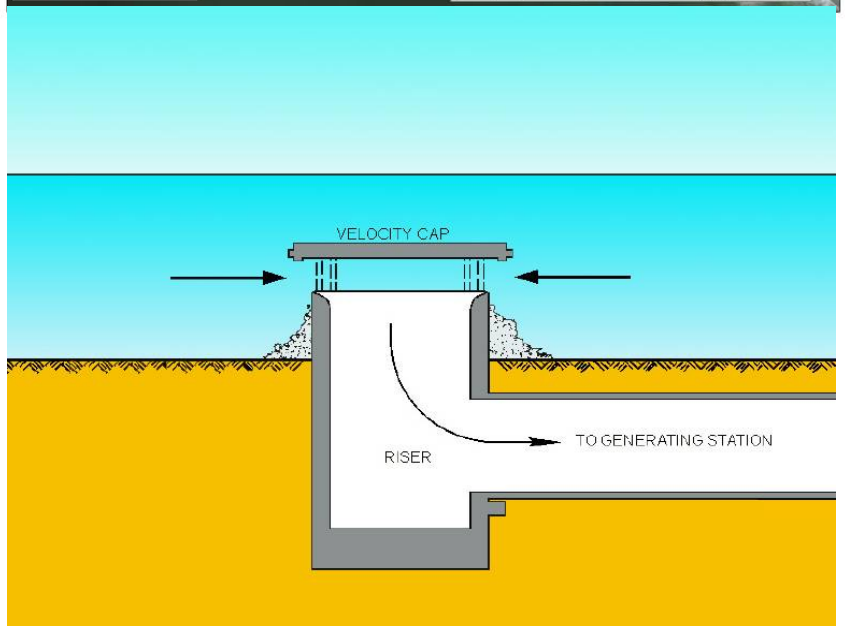
- Impingement
- Daily fish impingement averaged 7.8 lbs per day

Technologies and Operational Measures

Impingement Reduction

- Velocity cap at Huntington Beach was installed to provide fish protection.
- The velocity cap is estimated to reduce impingement within the 82%-87% performance standard range.
- Since all entrainment reduction technologies and operational measures being evaluated would also provide an impingement mortality reduction benefit, additional technologies that only reduce impingement mortality to meet the 95% reduction required by the permit will not be considered.

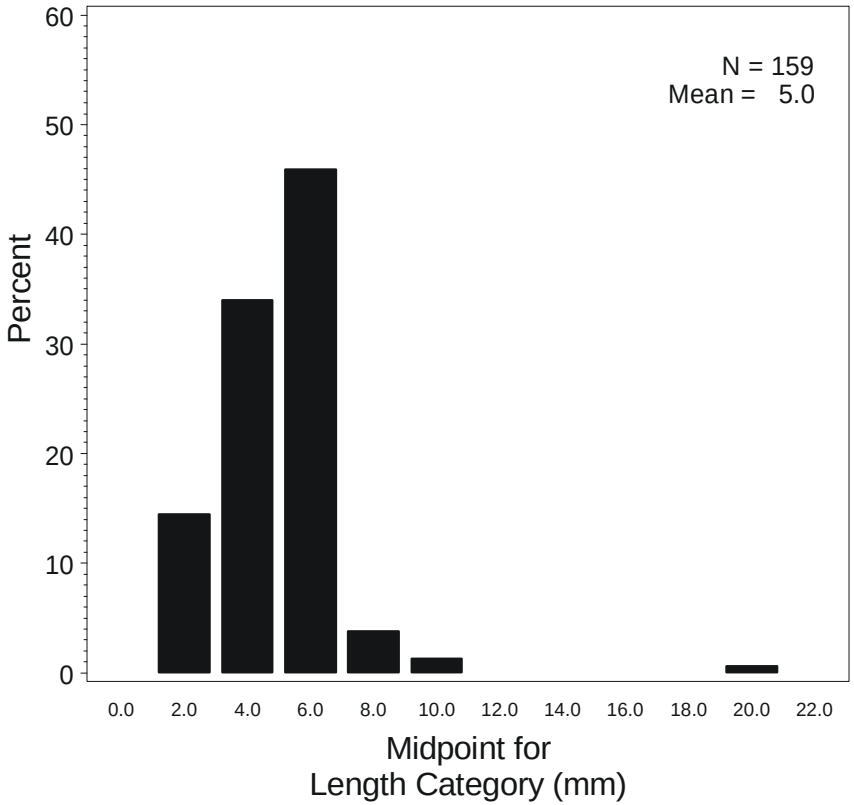




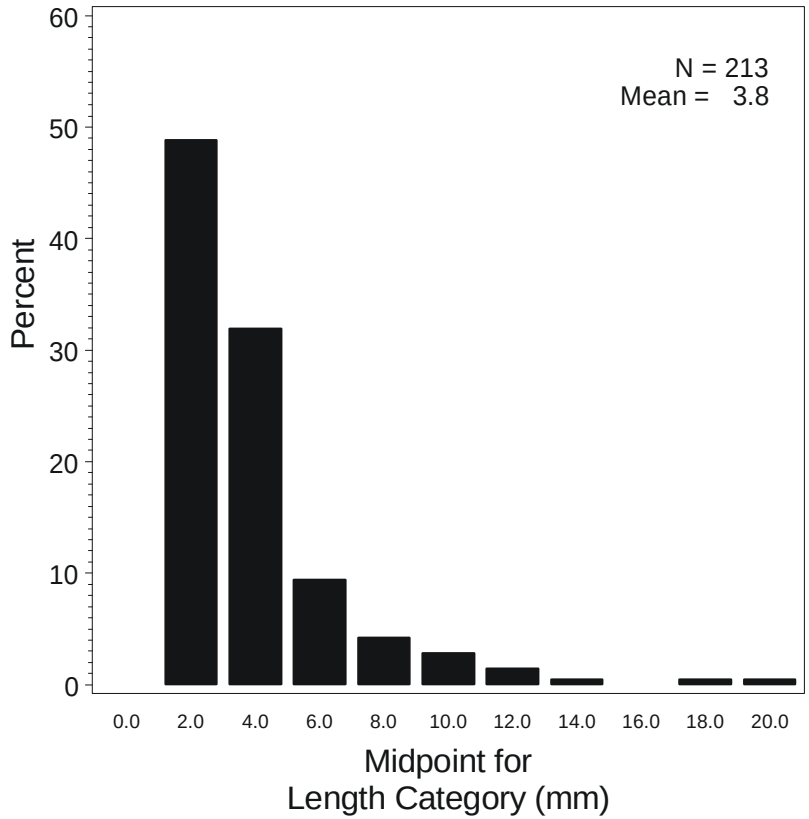
Entrainment Reduction Technologies and Operational Measures Under Evaluation for Huntington Beach

- Technologies and Operational Measures Under Evaluation:
- Fine-Mesh Traveling Screens
- Narrow-Slot Wedgewire
- Aquatic Filter Barrier
- Reduced Cooling Water
- Pump Operation
- Change in Intake Location
- Use of Reclaimed Water
- Closed-Cycle Cooling

Size Ranges of Dominant Entrained Species

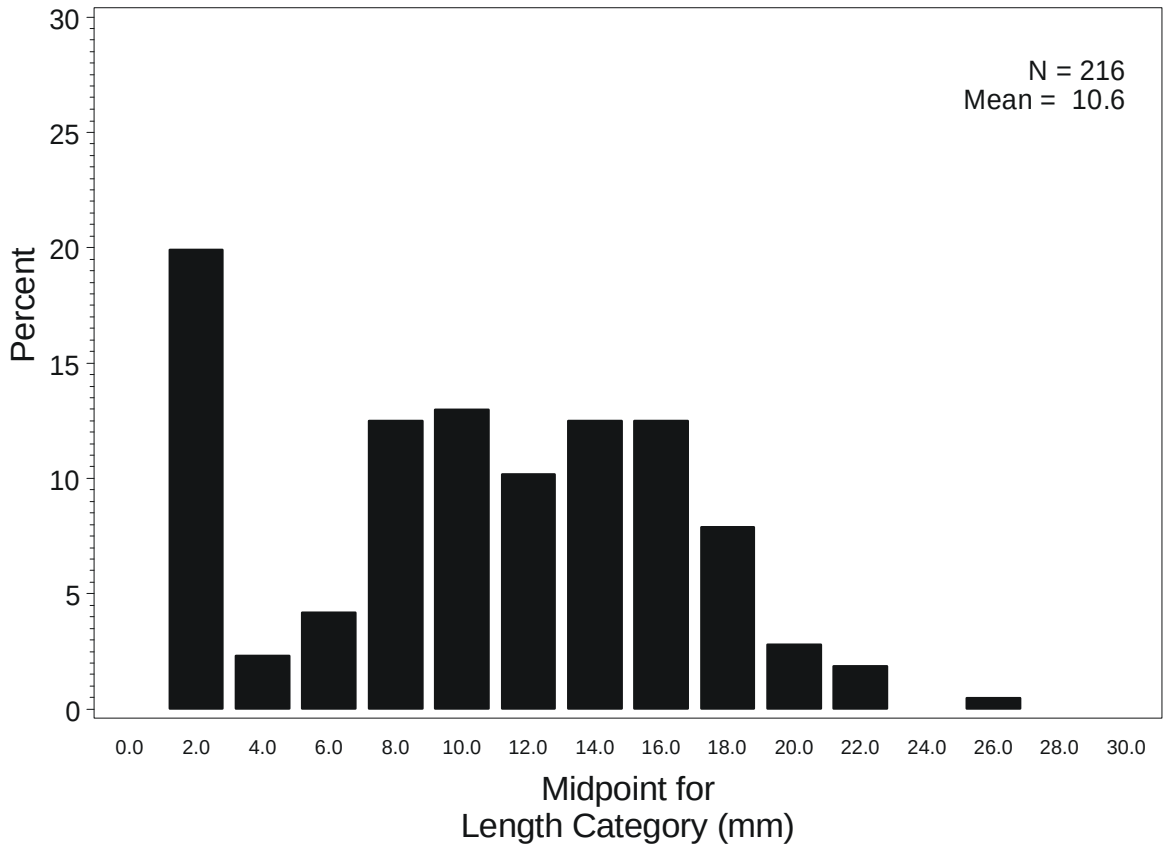


Queenfish



CIQ Gobies

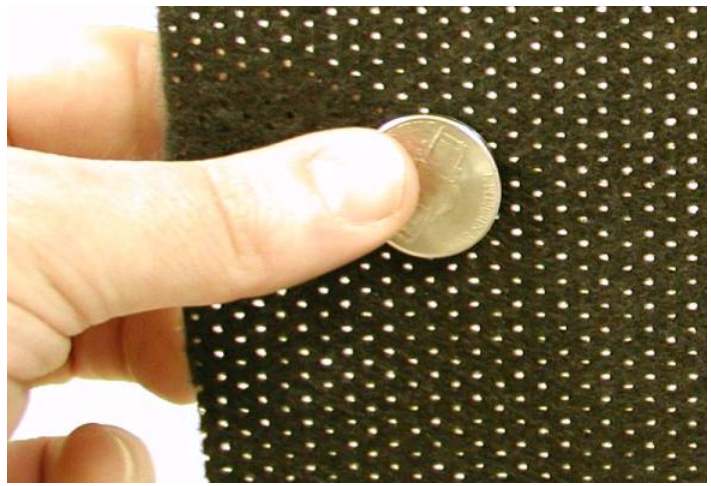
Size Range of Dominant Entrained Species



Northern Anchovy

Aquatic Filter Barrier

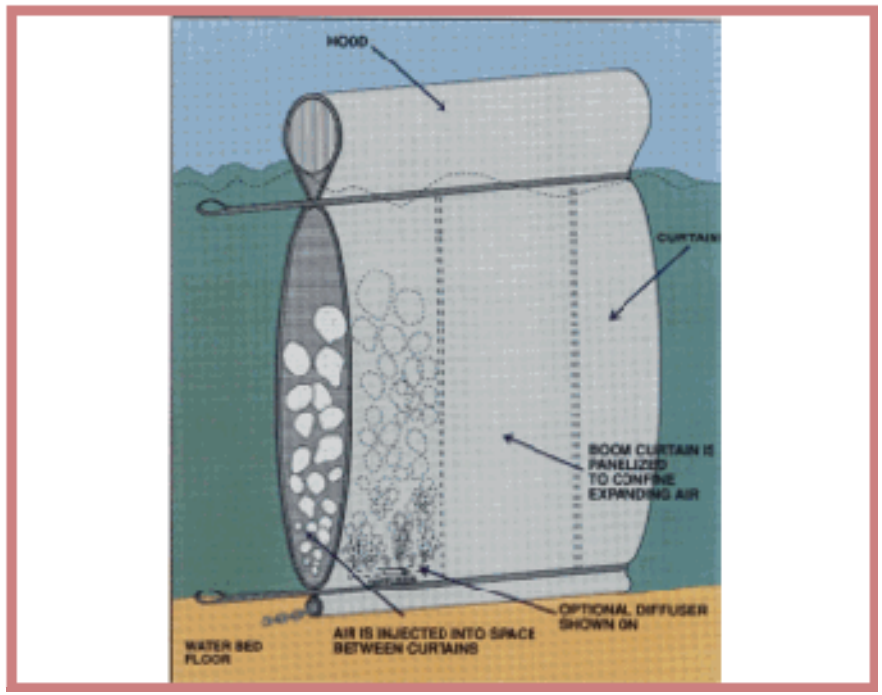
- Exclusion technology based on use of low through barrier velocity and sweeping current to carry away entrainable life stages
- Only one full-scale deployment (i.e. Lovett Generating Station on Hudson River)
- Most recent tests indicate good performance (i.e. high end of the performance standard range) for key species (bay anchovies and striped bass)



Aquatic Filter Barrier

Significant feasibility issues preclude use for Huntington Beach:

- No current design available for deployment in an open ocean environment. The current design has just overcome hydraulic issues for use in the Hudson River.
- Ability of air burst system may not fully address marine fouling



Fine Mesh Screens: Can they provide 60%+ Entrainment Reduction (survival)

Big Bend Fine Mesh (0.5 mm) Screen (TECO – Tampa Bay, FL)

EPRI is Currently Testing Rotary, Ristroph, and Hydrolox (molded plastic) Fine-Mesh Screens

Bottom Line for Fine Mesh Screens

- Based on EPRI 2007 studies on several freshwater species (carp, channel catfish and white sucker) survival rates were generally in excess of 60% for larvae >9mm and poor for smaller eggs and larvae.
- Due to poor survival of small eggs and larvae that predominate at Huntington Beach, this option is not expected to meet the performance standard

Species	Impingement Survival	Impingement + Handling Survival
California grunion (Hardy species)	80%	47%
Northern anchovy (Fragile species)	40%	0%

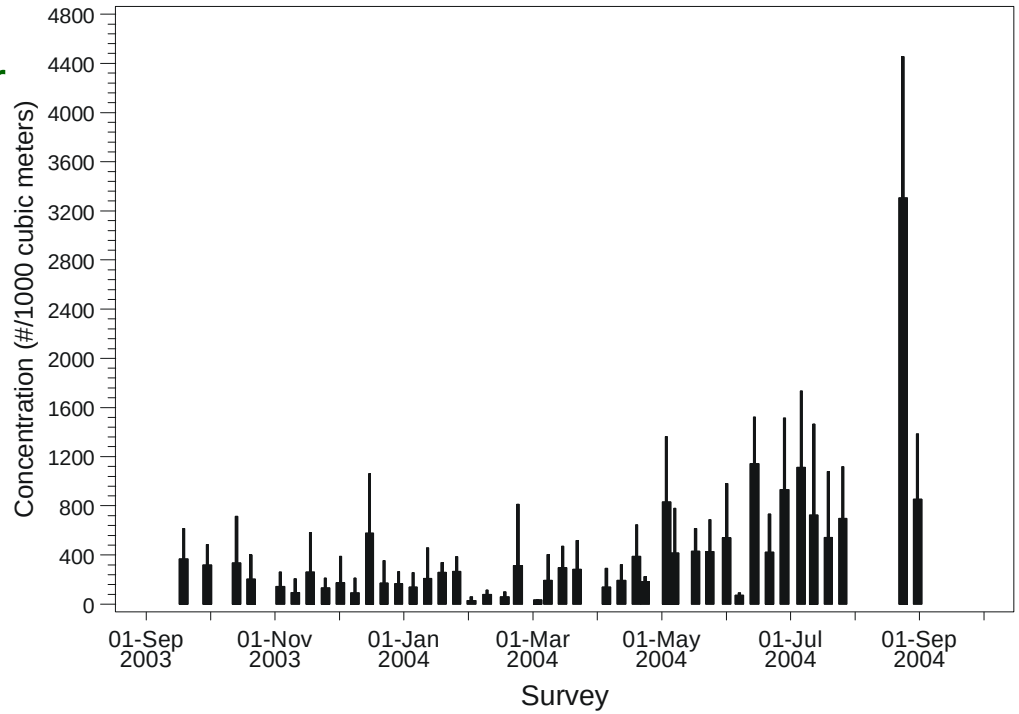
LMS Laboratory Studies at Redondo Beach in 1981

Reduced Cooling Water Pump Operation and/or Variable Speed Drives

- Cost of retrofitting cooling water pumps with variable speed drives estimated to be $2,330,000
- Reductions of flow would reduce efficiency that will cause and increase in fuel usage
- AES is evaluating to what extent flow can be reduced at Huntington Beach and meet contractual obligations to provide power to the CAISO Region.
- At best would need to be used in combination with other options

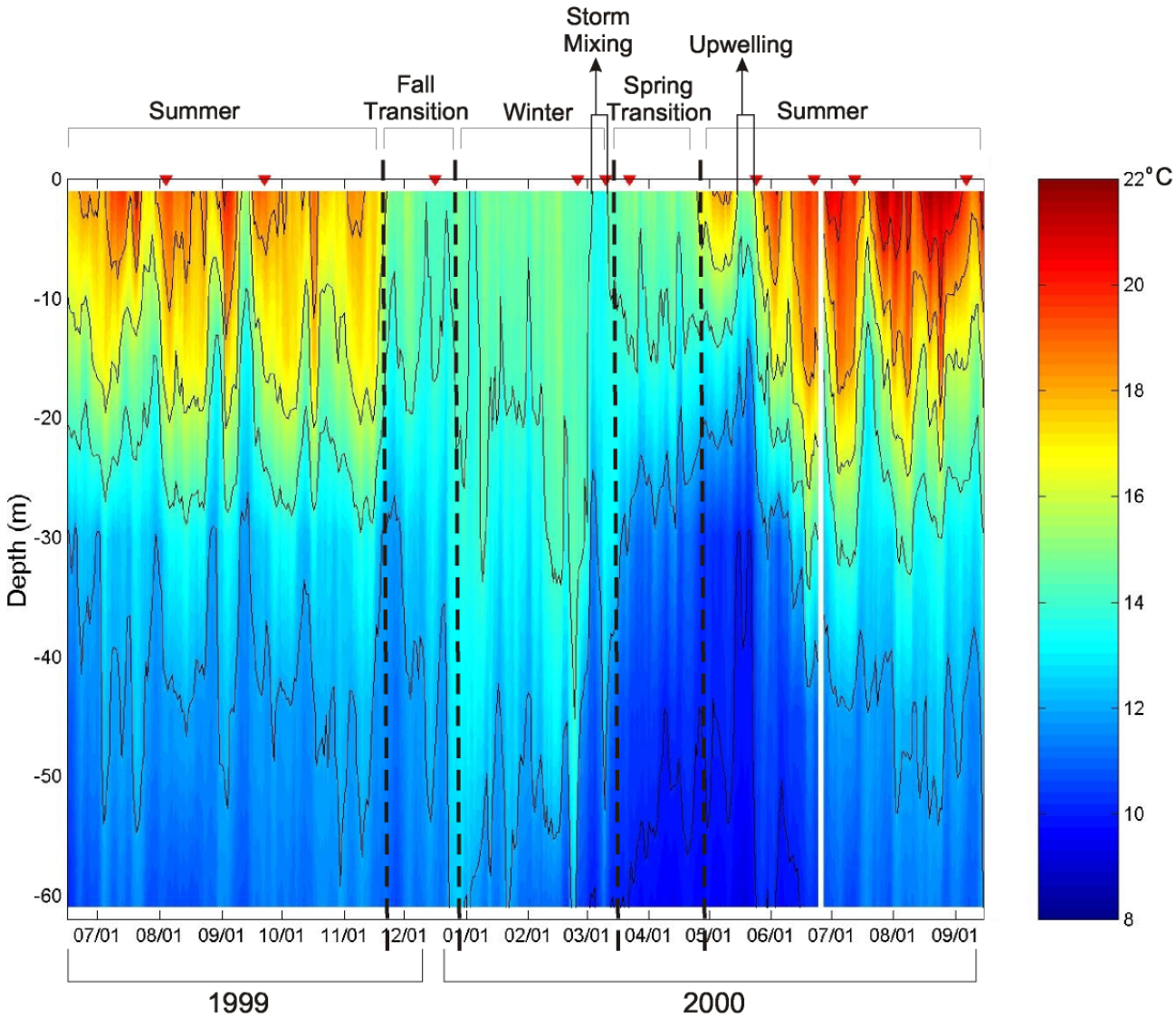
Reduced Cooling Water Pump Operation

- §316(b) Rule allowed proportionality assumption for entrainment and flow
- Variable speed drives could be installed for better flow control
- Feasibility Issues:
  - Direct relationship between flow and power generation
  - Peak energy demand coincides with highest entrainment densities
  - Phase II Rule and California Draft Policy required reduction from **actual** rather than design flow



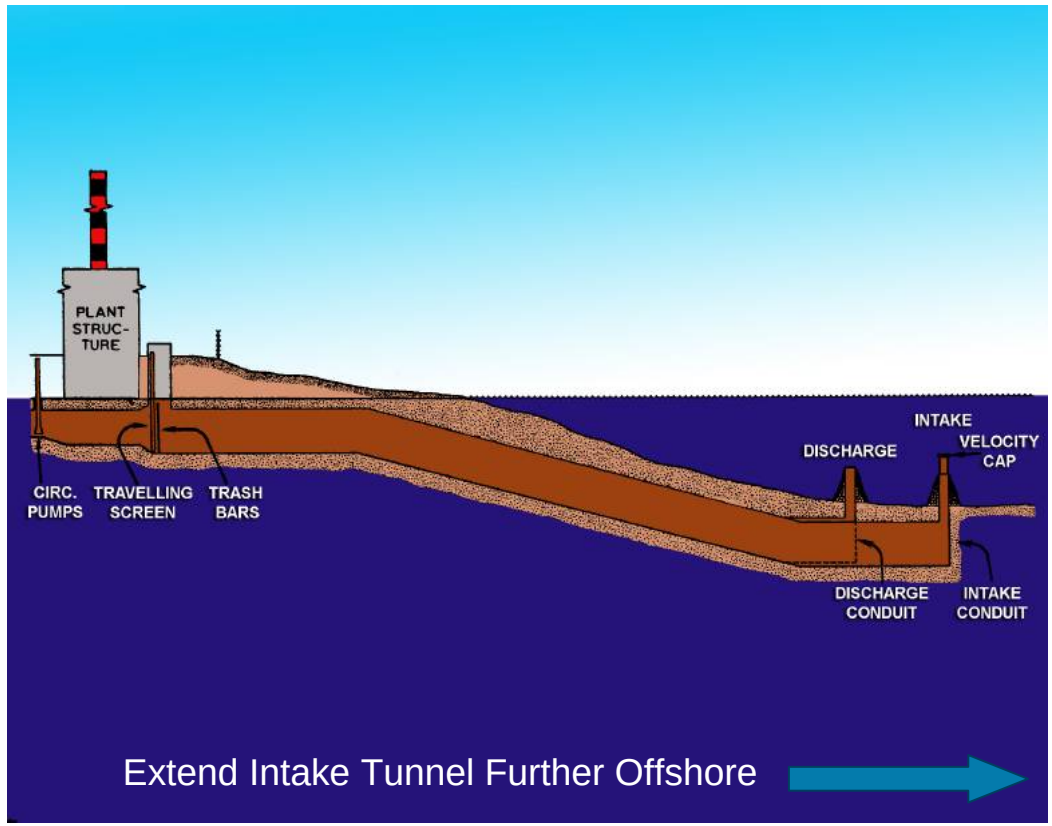
Seasonal Distribution of Larvae at the Hunting Beach Generating Station

Moving Intake Further Offshore



Change in Intake Location – Extending the Intake Further Offshore

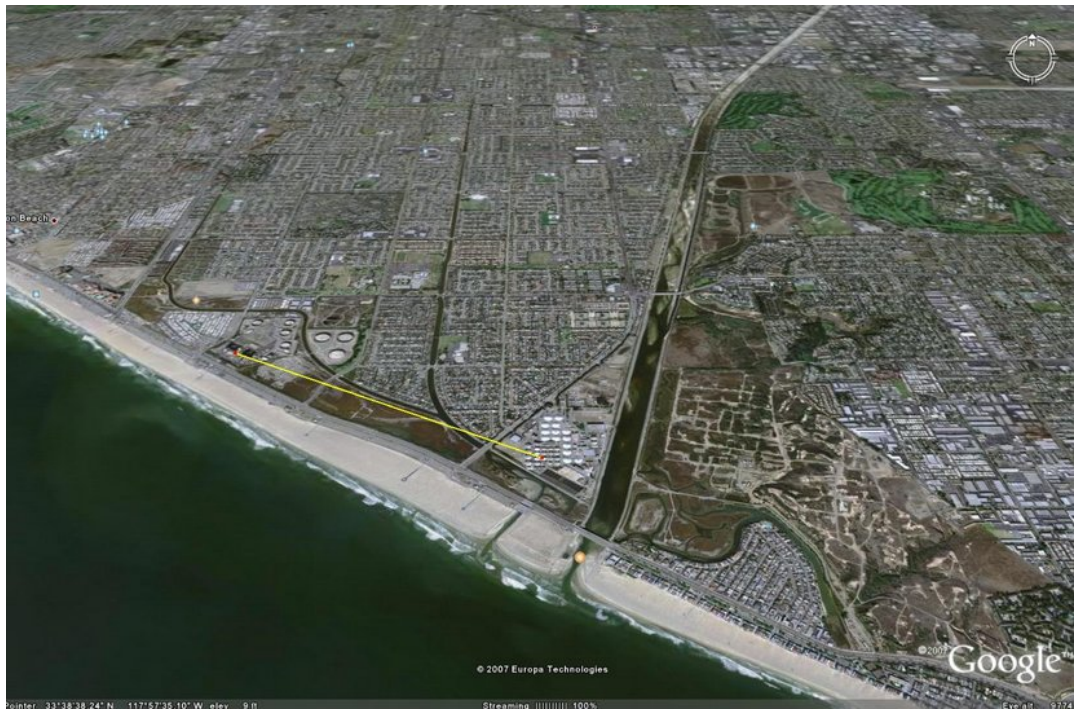
- Rule allowed credit for an entrainment reduction based on depth and/or offshore location
- It was suggested that if Huntington Beach extended the tunnel further offshore could reduce densities of entrainable organisms and reduce the amount of cooling water needed due to use of colder offshore water.
- Alden evaluated an extension to 5 miles offshore into water 100 ft in depth. This distance would allow withdrawal of water below the thermocline
- Uncertainty on species and life stages at that distance offshore so reduction benefit not clear.
- Preliminary cost estimates indicate costs are on the same order of magnitude as closed-cycle cooling.



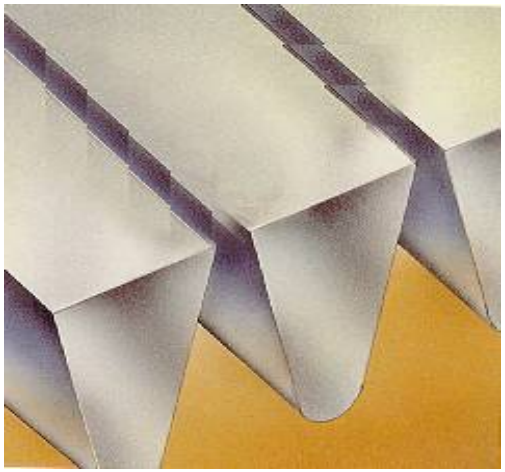
Use of Reclaimed Water

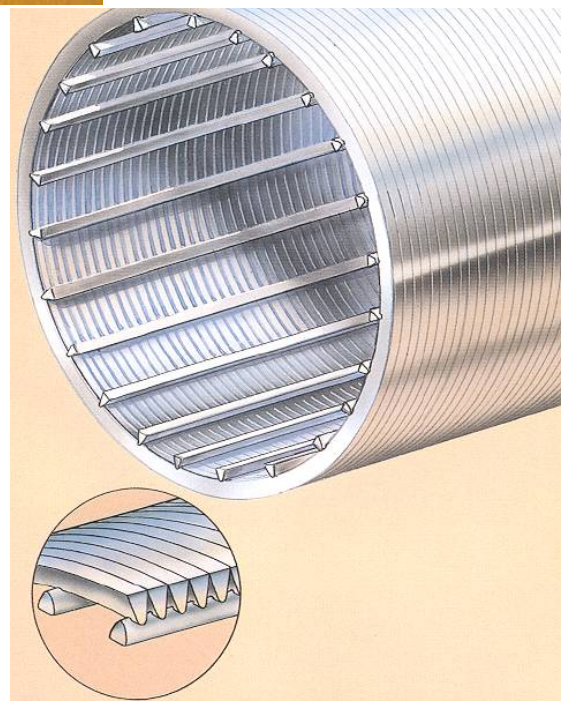
Reclaimed water has been used at a number of newer facilities (Argonne issued new report that can be downloaded at: http://www.ead.anl.gov/project/dsp_topicdetail.cfm?topicid=77) E:\DSCN1076.JPG

- AES has initiated an evaluation for use of reclaimed water from the Orange County Sanitation District
- This evaluation indicates there is potentially enough water to provide condenser cooling water to one of the four Units on a reliable basis.
- Additional issues in need of consideration include confirmation of reliable minimum flow, hotter water for condenser cooling, adequate flow based on current allocation commitments, materials impacts and discharge issues (thermal heating of effluent prior to discharge and/or reallocation).



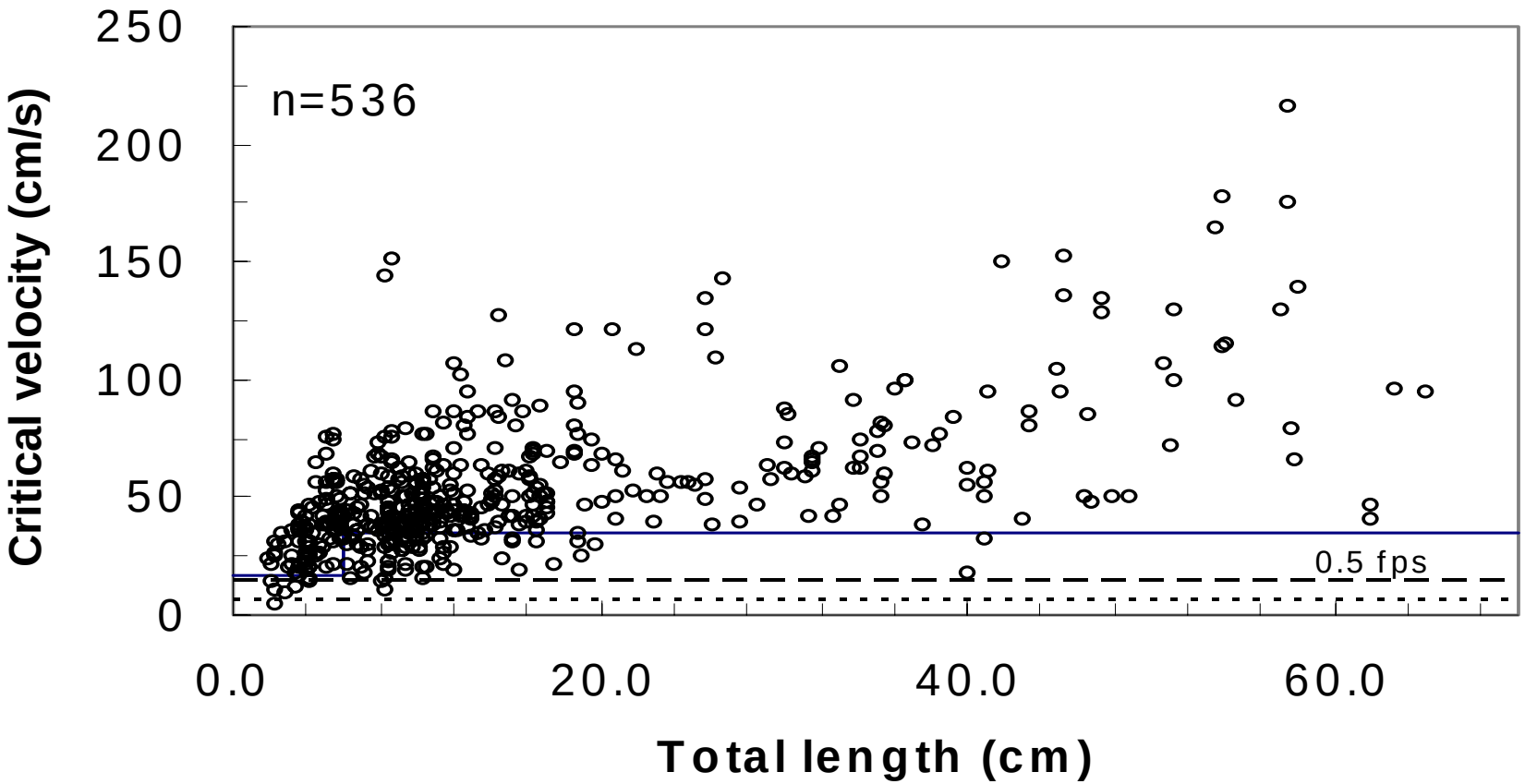
Narrow-Slot Wedgewire Screens



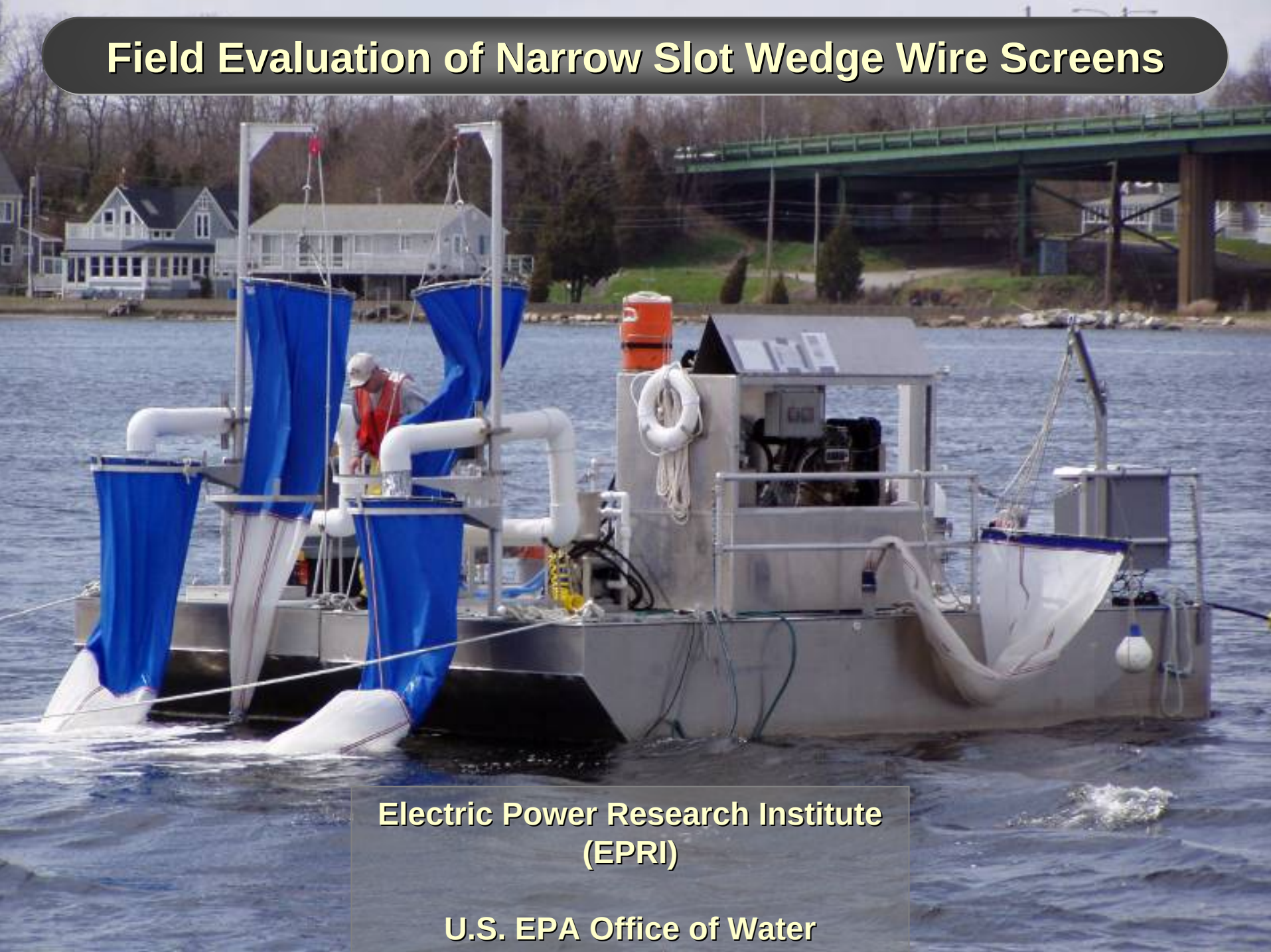


Under Rule Was Compliance Alternative 1 for Impingement

- Narrow-slot wedgewire designed with a through slot velocity not to exceed 0.5 fps



Field Evaluation of Narrow Slot Wedge Wire Screens



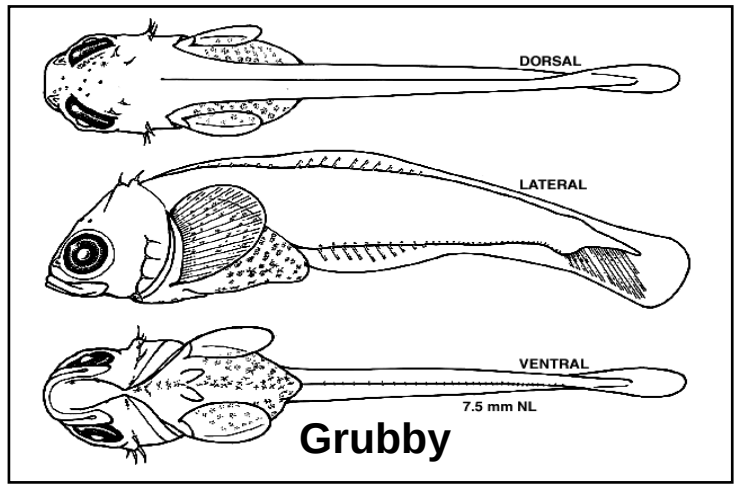
Electric Power Research Institute (EPRI)

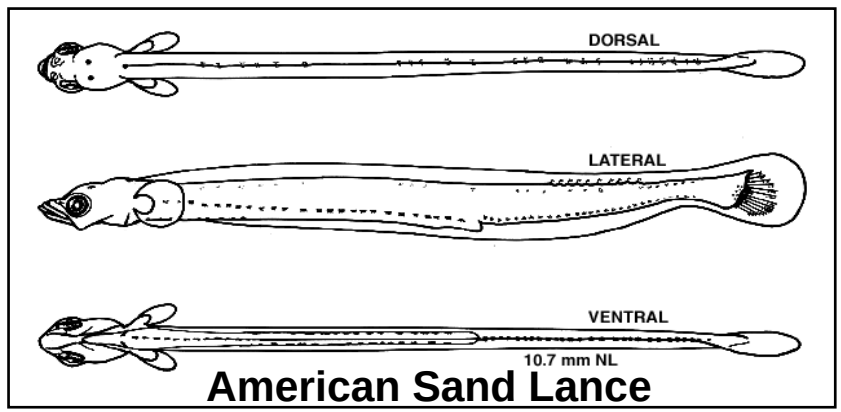
U.S. EPA Office of Water

Key Results

Field Evaluation of Wedgewire Screens for Protecting Early Life Stages of Fish at Water Intakes (EPRI 1010112, 2005):

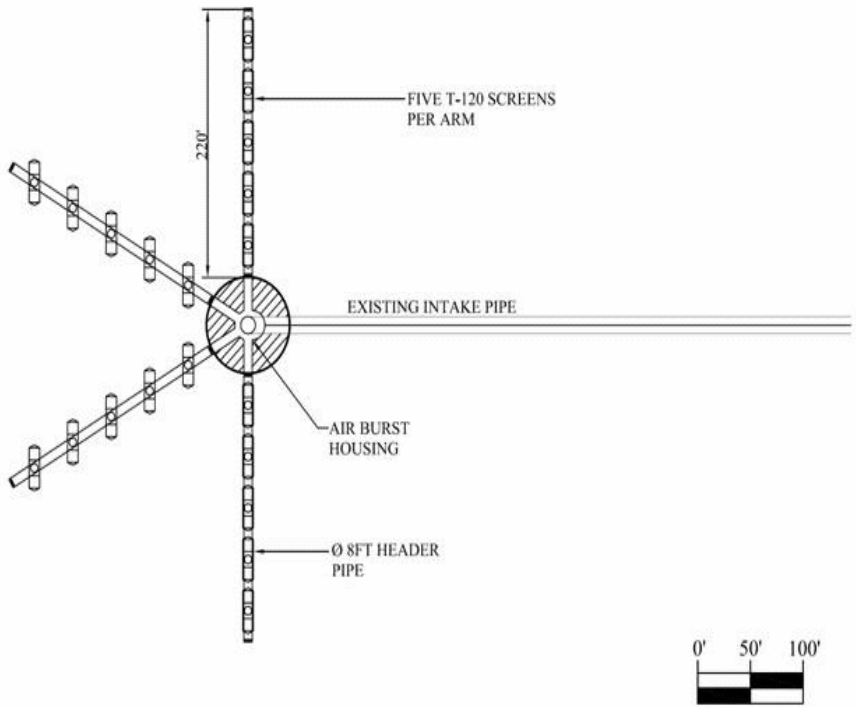
- Reductions varied by species, **egg diameter/larval length**, **slot size**, slot velocity, and sweeping flow
- 0.5 mm screens most effective (50-98% for larvae; 93-99% for eggs)
- Larval head width and egg diameter key variable for effectiveness – increasing data base for predictability of exclusion





Potential Offshore Deployment Configuration for Huntington Beach

- EPRI is currently engaged in an engineering design study to develop a workable design for wedgewire screen deployment at Huntington Beach
- Alden proposes use of 20 – 120 inch diameter modules to reduce the through slot velocity to 0.35 fps
- Ambient current velocities range from 0.3 to 0.7 fps.
- Will require offshore platform for module maintenance



Example Layout

Fouling and Debris Loading Control Option 1

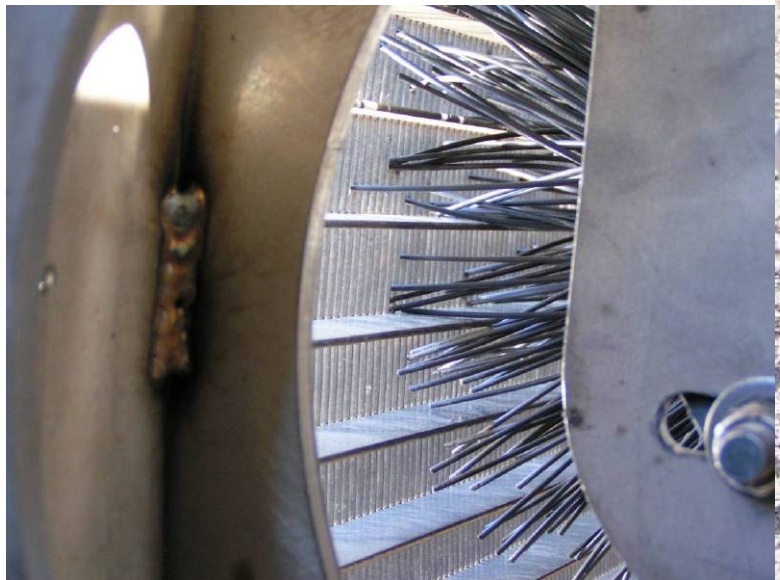
Air Blast System:

- Currently the primary method used for fouling control
- Issues:
  - Effectiveness in high fouling marine environments not yet demonstrated

Fouling and Debris Loading Control Option 2

Mechanical Cleaning:

- This option may avoid the need for an offshore platform but:
  - Untested in high fouling marine environment

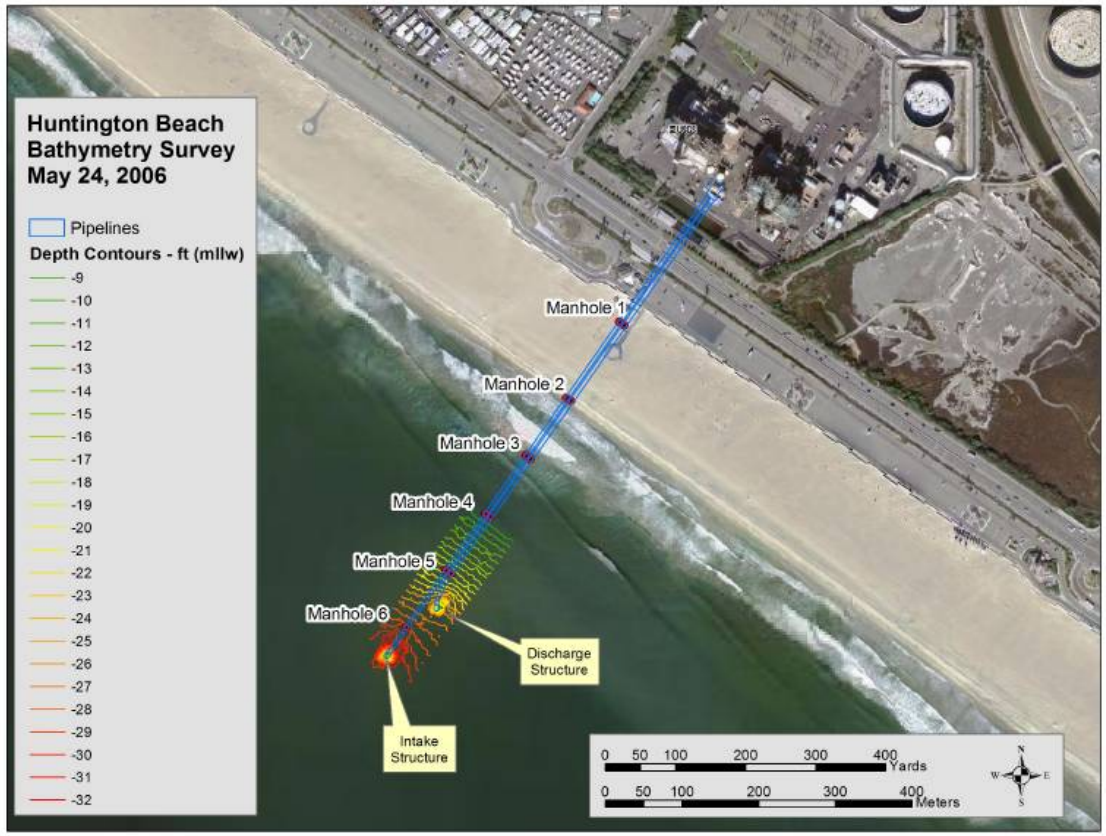


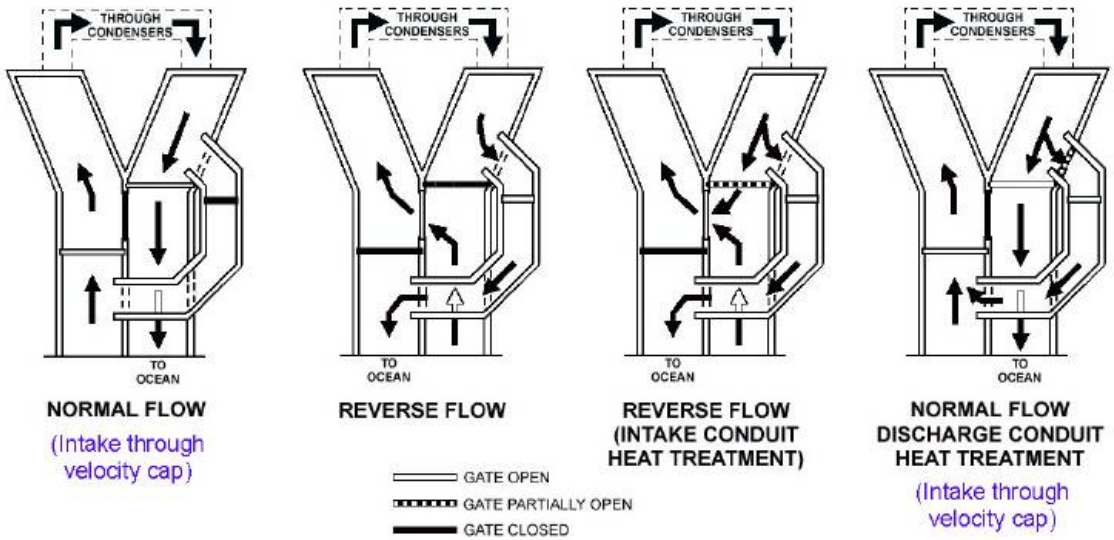
ISI Cylindrical "T" Screen *(Internal and External Brush System)*

Fouling and Debris Loading Control Option 3

Redundant System:

- Place modules on both the intake and discharge
- Use reverse flow to control fouling in the modules and to blow off debris on modules
- Issues:
  - Larger footprint on ocean floor
  - More frequent heat treatment





Bottom Line for Narrow-Slot Wedgewire

Likely to be the best performing alternative fish protection technology for Huntington Beach, but several issues still need to be addressed:

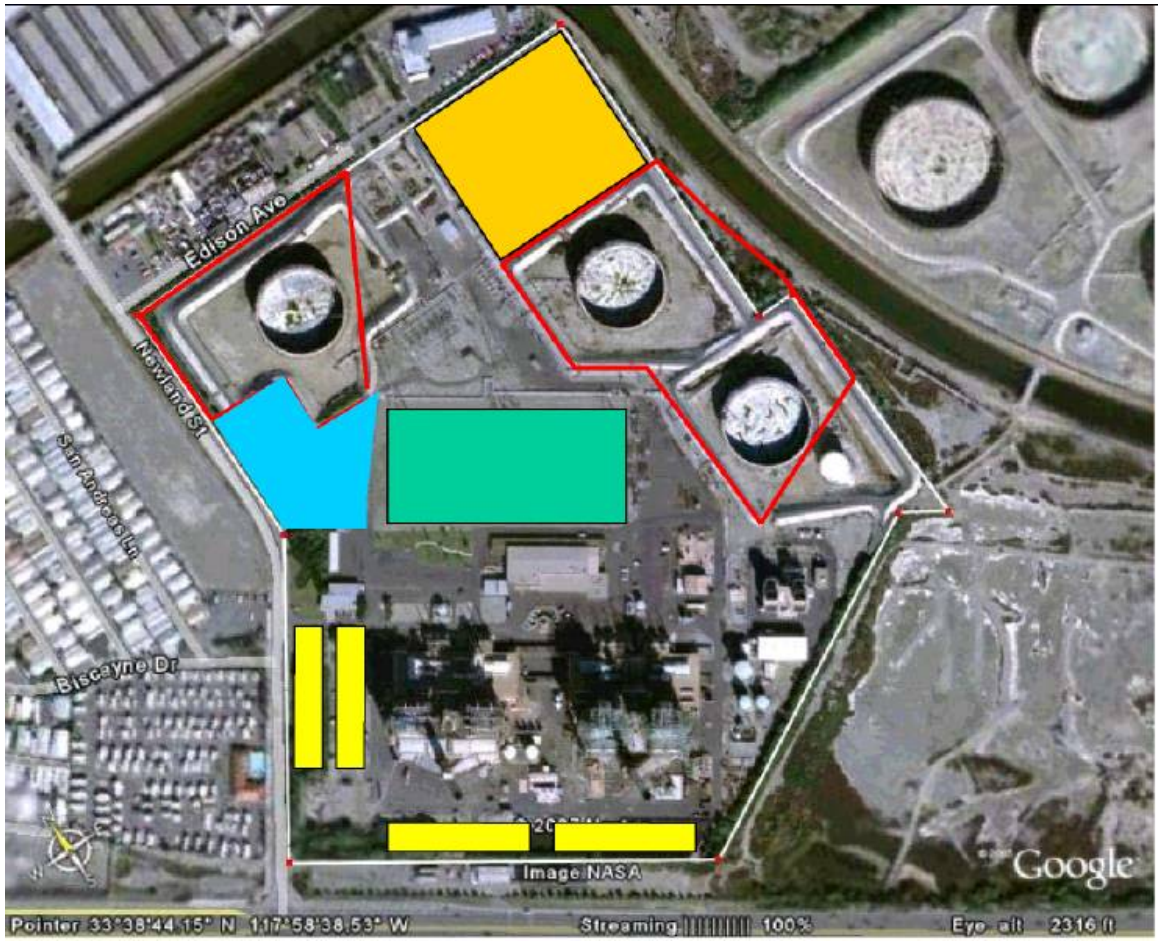
- Performance uncertainty regarding slot size (i.e. 0.5 mm is smallest wedgewire screen size in use)
- Biofouling Control:
  - Testing of air blast system to verify it can control marine fouling on modules needed and/or
  - Testing of mechanical cleaning system to verify feasibility in a marine fouling environment
  - Testing to determine frequency of reverse flow necessary to control fouling

Preliminary order of magnitude cost estimates indicate the upper end cost estimate could approximate close-cycle cooling

Use of Closed-Cycle Cooling at Huntington Beach

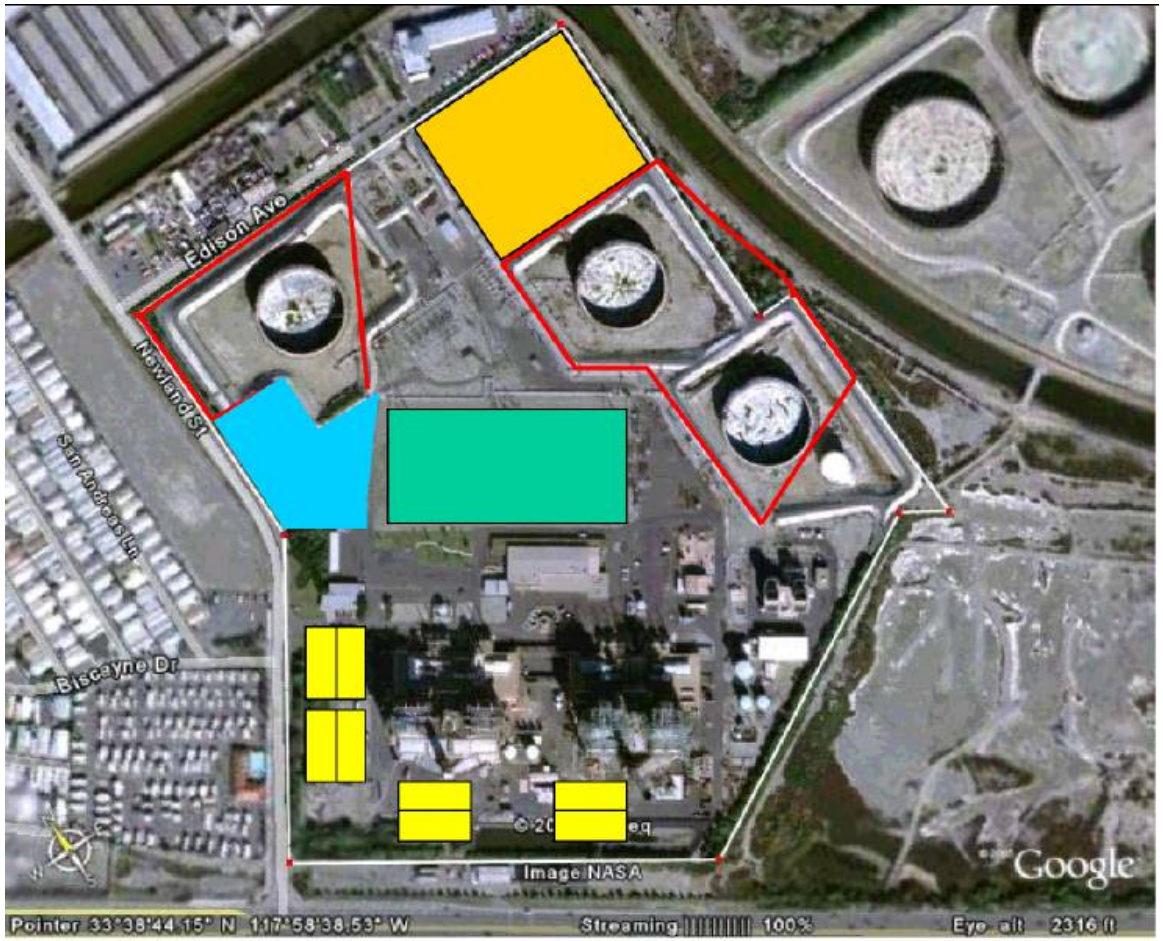
- HBGS has evaluated use of closed-cycle cooling
- Evaluation considered use of both wet and dry systems
- Evaluation included space considerations in tandem with Poseidon requirements
- Current EPRI closed-cycle cooling retrofit report undergoing peer review.

Closed-Cycle Cooling Tower Location Option 1



Green – SCE
Blue – Pacific Pipeline
Red – Poseidon
Yellow – Closed-Cycle Cooling Towers
Orange – City of Huntington Beach

Closed-Cycle Cooling Tower Location Option 2



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Closed-Cycle Cooling Cost Estimates for Huntington Beach

Cooling System	Current Study
Wet Mechanical Draft Towers*	$99,000,000
Dry Cooling	$197,500,000

* Cost estimate assumes plume abatement and state of the art drift eliminators would be required.

Closed-Cycle Cooling Social and Environmental Impacts

- Potential impacts include:
  - Air Quality due to fine particulates
  - Water Quality due to concentration of ambient water contaminants
  - Land/Wetland impacts due to salt drift
  - Noise
  - Fogging
- EPRI has initiated a project to quantify

››Questions?